ORIENT PAPER MILLS - CAUSTIC SODA UNIT, AMLAI, ANUPPUR (M.P.)

PRODUCT STEWARDSHIP SUMMARY

CAUSTIC SODA (Sodium Hydroxide)

Membrane Grades

Synonyms	:	Sodium Hydroxide, Caustic Soda, Caustic Lye
Chemical Formula	:	NaOH
Molecular Weight	:	40.0
Description	:	Caustic soda solutions are colorless and strongly alkaline, not support combustion.

Product Overview

Caustic soda is an essential ingredient in many industrial and commercial applications. It is a strong, colorless alkali. Caustic soda is manufactured through the electrolysis of sodium chloride (salt brine). There are three process of electrolysis for manufacturing of Caustic Soda Lye i.e. Diaphragm Cell, Mercury cell and Membrane cell.

Production

The process of manufacture of caustic soda and chlorine by Ion Exchange Membrane (IEM) process consists of the following sections:

- Primary Brine section
- Secondary and depleted brine section
- Electrolyzing section

In primary brine section, a saturated solution of sodium chloride is prepared in raw salt dissolver where from is taken to a series of mixing reactors for chemical purification of the crude brine. Impurities like calcium, magnesium, iron, sulphate, silica etc. are removed from the crude brine in these reactors. The process is exactly like the brine purification process in mercury cell plant except that sulphate is removed by adding barium carbonate.

The brine from mixing reactors goes to the clarifier for settling of the sludge which is drained periodically by a time operate control valve in to the sludge tanks. The clear brine from clarifier goes to a tank where from goes to the anthracite filter for filtration of suspended particles. From anthracite filter brine goes to the polishing filter (Alpha Cellulose) for further improvement of its quality At this stage the hardness of the brine comes down to less than 1.0 ppm (parts per million) level.

The outlet of polishing filter goes to the secondary brine section for removal of last traces of hardness in an ion exchange resin column (Chelae Resin) Hardness of the brine gets reduced to less than 20 ppb (Parts per billion) level. This ultra pure brine is collected in a tank where from it is pumped to a overhead tank with acidification upto pH 4.0 ~ 5.0 Which is called feed brine head tank. Feeding of brine to cells is done

by gravity without the use of any pump. The above noted chelae resin columns require to be re- activated after a definite time interval. This is a fully automatic process based on microprocessor technique.

The ultra pure brine as noted above then goes to the cells which are having two chambers called cathode chamber and anode chamber separated by a membrane.

Feed brine enters the anode chamber whereas dilute caustic enters the cathode chamber. During electrolysis following reaction takes place.

$$2NaCl + 2H_2O \longrightarrow 2NaOH + Cl_2 + H_2$$

After electrolysis depleted brine with chlorine which is called anolyte comes out from the anode chamber and is taken to chlorine gas separator for stripping of chlorine gas. The dechlorinated brine goes to primary brine section for resaturation.

The catholyte which is a mixture of product caustic with hydrogen gas goes to the hydrogen gas separator. The product caustic (31.0 % ~ 32%) is taken to a receiving tank from where it is fed to the caustic concentration plant for concentrating up to 48%. A portion of the product caustic is diluted with D.M. water and is recycled to the cathode chamber for continuous operation of the process. The hydrogen gas separated out from catholyte tank is taken to a gasholder where from it goes to the hydrochloric acid plant for manufacture of hydrochloric acid. The chlorine gas goes to the chlorine plant for manufacture of liquid chlorine, hydrochloric acid or bleach liquor as described under chlorine plant.

Uses

Caustic soda has a wide variety of applications based primarily on its ability as a strong alkali to react with many substances. It is a stronger base and faster reactant than other alkalis. It is much more stable in water and can be economically stored and transported in solution form. It also does not form undesirable by-products such as carbon dioxide or other insoluble carbonates. The largest uses for caustic soda are pulp and paper manufacturing, alumina production, de-inking of waste paper, water treatment, and general chemistry. Caustic soda is a basic feedstock in the manufacture of a wide range of chemicals. It is used as an intermediate and a reactant in processes that produce solvents, plastics, synthetic fibers, bleach, adhesives, coatings, herbicides, dyes, inks, and pharmaceuticals such as aspirin.

It is also used in soap and detergent, oil and gas, and textile industries as well as to neutralize acidic waste streams and the scrubbing of acidic components from off-gases. With all downstream applications, appropriate registrations and/or approvals may be required. Possible uses are described below:

- **Chemical Production -** The chemical industry consumes nearly 40% of the caustic soda produced as a basic reagent for a multitude of general industrial applications.
- **Pulp and Paper** - Both sulfate and sulfite pulps are purified by removing lignin compounds in the caustic extraction stages of multistage bleach plants. In some kraft mills, caustic soda is also used as a makeup chemical. It is also used as the initial treatment in deinking secondary fibers.

- **Rayon and Cellophane -** Fiber production by the viscose process requires caustic soda at two main stages. Cellulose is treated with caustic soda solution to mercerize it and form alkali cellulose, which is then dissolved in caustic soda solution to form viscose prior to extruding rayon fibers and cellophane films.

- **Alumina Extraction -** Caustic soda is used to digest bauxite ore, precipitating alumina (aluminum oxide). It is also used as an etchant in the finishing and chemical milling of aluminum products.

- **Soapmaking** - Caustic soda saponifies fats into water soluble sodium soaps.

- **Textiles** - Used in scouring, bleaching, desizing, lustering and mercerizing.

- **Petroleum Production and Refining** - Caustic soda is used as an absorbent for carbon dioxide in light petroleum fractions; as an absorbent for sulfides in the purification of various fractions; and with chlorine for hypochlorite sweetening, a treatment step in the removal of various sulfur compounds.

- **Soda Ash Replacement -** Caustic soda can be used interchangeably for many applications in glass, paper, pulp, phosphates and silicates industries.

- **Renewable Fuels** - Caustic soda is used for pH adjustment and formation of in situ sodium methylate in bioethanol and biodiesel processing.

Health Effects

This material is extremely corrosive and highly reactive. Read and follow all instructions on the product label and review the Material Safety Data Sheet (MSDS) to understand and avoid the hazards associated with caustic soda. Do not get caustic soda in eyes, on skin, or on clothing. Eye contact with caustic soda mist or solution usually results in immediate pain and can cause permanent eye damage including blindness. Skin contact may result in irritation, which may not be immediately painful. Caustic soda solution is highly toxic by ingestion and may cause severe burns of the mouth, throat, and stomach even with short exposure. Inhalation of caustic soda as a dust, mist, or aerosol may cause respiratory irritation that can develop into serious lung injury depending on the degree of exposure.

The United States Occupational Safety and Health Administration (OSHA) and the American Conference of Governmental Industrial Hygienists (ACGIH) have established occupational airborne exposure limits for caustic soda. The OSHA Permissible Exposure Limit (PEL) is an 8 hour Time-Weighted Average (TWA) of 2 mg/m (milligrams per cubic meter). The ACGIH Threshold Limit Value (TLV) is a Ceiling Limit of 2 Mg/m. A Ceiling Limit should not be exceeded during any part of the working exposure.

Before handling, it is important that engineering controls are operating and protective equipment requirements and personal hygiene measures are being followed. People working with this chemical should be properly trained regarding its hazards and its safe use.

Environmental Effects

Caustic soda is very toxic to aquatic life and should be kept out of lakes, streams, ponds, or other water sources. Caustic soda does not bio accumulate due to its high solubility in water.

Exposure Potential

Since caustic soda is corrosive precautions should be taken to minimize potential harm to people, animals and the environment. Potential for exposure may vary depending upon site-specific conditions. When handling caustic soda, refer to the Material Safety Data Sheet and Product Warning Label and follow all instructions and warnings. Based on the expected uses for caustic soda, exposure could be through:

- **Workplace exposure** - Exposure can occur either in a caustic soda manufacturing facility or in the various industrial facilities that use caustic soda. Caustic soda has been used for more than 50 years by industry. When exposures occur, they are most frequently to the skin and eyes, although oral exposure and ingestion are possible. Good industrial hygiene practices minimize the risk of exposure. Additionally, most processes using caustic soda is used in closed tanks and vessels.
- **Environmental releases** - In the event of a spill, the focus is on containing the spill to prevent contaminated soil, surface or ground water. Caustic soda can significantly increase the pH of soil and/or water. Industrial spills (releases to soil or water) are infrequent; however, when they do occur, they are controlled by workplace spill programs which include containment around loading and unloading operations and storage tanks and employee training. Refer to the material Safety Data Sheet for instructions to contain and clean up a spill to minimize exposure.
- **Consumer exposure** - Caustic soda is not sold directly to community consumers; however it is an ingredient in some consumer products. Keep all chemical products out of the reach of children.

Safe Handling and Storage

Caustic soda is corrosive and reactive. Always take precautions to minimize potential harm to people, pets, and the environment. When making solutions or diluting, caustic soda should only be added slowly to the surface of cold water while stirring. Do not add to warm or hot water because a violent eruption or an explosive reaction can result. Avoid contact with organic materials and concentrated acids as this may cause violent reactions.

Besides reacting vigorously with many organic and inorganic materials, caustic soda attacks certain metals including aluminum, magnesium, zinc, tin, chromium, brass, and bronzes made with zinc or tin. Since galvanizing is done with zinc, liquid caustic soda will attack galvanized iron surfaces. The reaction may be dangerous because hydrogen is generated and may introduce an explosion hazard. Caustic soda can also react with various food sugars to generate hazardous carbon monoxide gas.

The dilution of caustic soda solutions produces considerable heat and may cause boiling, spattering, or violent eruption. Workers are properly instructed in dilution procedures and exercise caution.

Packaging and Transportation and Disposal Of Packing Material

Caustic soda lye is stored in closed M.S.Tank. Caustic soda lye is transported through Tankers. Caustic Soda Flakes is packed in 50 kg HDPE bags with liner and transported through Trucks, for the disposal of the packing material

Physical and Chemical Properties

Caustic soda lye is an odorless and colorless liquid. In all forms, caustic soda is highly corrosive and reactive. Caustic soda reacts readily with metals such as aluminum, magnesium, zinc, tin, chromium, bronze, brass, copper, and alloys containing these metals. Galvanized (zinc coated) materials and contact with acids, halogenated organics, organic nitro compounds, and glycol should be avoided. Caustic soda reacts with most animal tissue, including leather, human skin, and eyes. It also reacts readily with various reducing sugars (i.e., fructose, galactose, maltose) to produce carbon monoxide. Hazardous carbon monoxide gas can form upon contact with food and beverage products in enclosed vessels and can cause death.

Properties of Liquid Caustic Soda Caustic Soda	31%-32%	98%
Boiling Point	288°F (142°C)	372°F (189°C)
Melting Point (Crystallization Begins)	50-55°F (10-13°C)	140-144°F (60-62°C)
Solidification Point	41°F (5°C)	140°F (60°C)
Specific Gravity@30°C	1.332 – 1.343	2.13

Regulatory Information: The caustic soda Material Safety Data Sheet contains regulatory information, including Global Chemical Inventory Status information.

Additional Product Information:

Source - Caustic soda is derived from a mineral source and has not been derived from plant, animal, synthetic, petroleum or fermentation sources.

Allergenic Materials - Caustic soda is not manufactured using any of the following allergenic materials: carmine/cochineal extracts, celery, colors/color additives, dyes/food dyes, eggs/egg products, seafood/fish/shellfish/crustaceans, flavors, glutens, legumes, milk, mollusks, monosodium glutamate (MSG), mustards, plant nuts/seeds/oils (sesame, sunflower, safflower, canola, etc.), peanuts/peanut products, protein hydrolysates, soy/soybeans/soybean products, spices, sulfites, sulfates, tree nuts/tree nut oils and wheat.

Bovine Spongiform Encephalopathy - Caustic soda is not of animal origin, and does not contribute to Transmissible Spongiform Encephalopathy (TSE)/Bovine Spongiform Encephalopathy (BSE).

Genetically Modified Organisms (GMOs) - Caustic soda is not manufactured with and does not contain genetically modified organisms.

Natural Latex Rubber - Caustic soda is not manufactured with and does not contain natural latex rubber.

Nutritional Value - Caustic soda does not have nutritional value.

Product Stewardship: OPM-CSU is committed to managing caustic soda lye and flakes so that it can be safely used by its employees and customers. OPM-CSU's relationships with its customers encourage communication about safety and environmental stewardship.

Additional Information

For more information regarding OPM-CSU's caustic soda lye & Flakes, contact our customer service department by calling 18-00-111735 Or, Orient Paper Mills - Caustic Soda Unit, Distt. Anuppur, Madhya Pradesh – 484 117 India.

Notice

Prior to its use, the user is responsible for determining the suitability of the product or products covered by this Product Stewardship Summary and for complying with state, local laws and regulations in connection with its use. Neither OPM-CSU nor any of its affiliates shall be responsible for any damages of any kind whatsoever resulting from the use of or reliance on this Product Stewardship Summary or product or products to which it refers.

This Product Stewardship Summary is intended only to provide a general summary of the potential hazards associated with the product or products described herein. It is not intended to provide detailed information about potential health effects and safe use and handling information and, although OPM-CSU believes this information is correct; OPM-CSU makes no warranties as to its completeness or accuracy. Appropriate literature has been assembled which provides information concerning the health and safety precautions that must be observed when handling the OPM-CSU product(s) mentioned in this document. Before working with any of these products, users must read and become familiar with the available information on product hazards, proper use, and handling. Information is available in several forms, such as Material safety data sheets (MSDS) and product labels. A copy of OPM- CSU's MSDS for caustic soda lye and Flakes can be obtained by company.

This information is subject to change without notice.
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